Lecture 10-2-3 Trees B Trees

1. In a 2-3 tree, what characterizes a 3-node?
A) One key and two children
B) Two keys and three children
C) Three keys and two children
D) Three keys and four children
Answer: B

2. What happens when inserting a key into a full 3-node in a 2-3 tree?
A) Promote the smallest key to the parent
B) Split the node into two 2-nodes, and promote the middle key to the parent
C) Split the node into three 2-nodes
D) Rotate the tree to maintain balance
Answer: B

3. During B-tree insertion, if a leaf node exceeds its capacity, what is the correct action?
A. Delete the smallest key.
B. Split the node, and promote the middle key to the parent
C. Rotate keys with a sibling.
D. Merge the node with its parent.
Answer: B

4. When a B Tree's root node splits during insertion, what happens to the tree height?
A) It decreases by 1
B) It remains the same
C) It increases by 1
D) It becomes unbalanced
Answer: C

5. What is the primary advantage of B Trees over binary search trees for large datasets?
A) Reduced tree height, minimizing disk probes
B) Support for non-numeric keys
C) Simpler deletion operations
Answer: A

6. Which tree type guarantees that all leaf nodes are at the same level?
A) Binary Search Tree
B) AVL Tree
C) 2-3 Trees and B Trees

D) Red-Black Tree
Answer: C

7. Which data structure is commonly used in databases and file systems?
A) AVL Tree
B) Binary Heap
C) B Tree
D) Linked List
Answer: C

8. How do B Trees differ from AVL trees?
A) B Trees are binary, while AVL trees are multi-way
B) B Trees are optimized for disk access, while AVL trees are in-memory structures
C) AVL trees guarantee balance, but B Trees do not
D) B Trees use rotations, while AVL trees use splitting
Answer: B

9. How does increasing the order M of a B Tree affect its height?
A) Height increases exponentially
B) Height decreases
C) Height remains constant
D) Height becomes unpredictable
Answer: B

10. For a B Tree of order 5, what is the maximum number of keys in a single node?
A) 3
B) 4
C) 5
D) 6
Answer: B

11. For a B-tree of order 5, what is the minimum number of keys in a non-root node?
A. 1
B. 2
C. 3
D. 4
Answer: B

12. For a B-tree of order 5, what is the minimum number of keys in the root node?
A. 1
B. 2
C. 3
D. 4
Answer: B

13. What is the maximum total number of keys in a B-tree of order 5 and height 2?
A. 3
B. 4
C. 24
D. 124
Answer: D

14. Which tree structure is a special case of a B-tree with $M=3$?
A. AVL tree
B. 2-3 tree
C. Red-black tree
D. Binary search tree
Answer: B

15. If a B-tree of order M has n keys, its worst-case search complexity is:
A. $O(n)$
B. $O(\log n)$
C. $O(M)$
D. $O(Mn)$
Answer: B

16. What is the minimum height of a B-tree with $n=63$ keys and $M=4$?
A. 2
B. 3
C. 4
D. 5
Answer: A (Since $\log_4(63+1)-1=2$)